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One- and Two-Dimensional Arrangement of DNA-Templated Gold Nanoparticle Chains using Plasma Ashing Method

Hyung Jin Kim, Byungyou Hong

성균관대학교 정보통신공학부

Electron-beam lithography (EBL) process is a versatile tool for a fabrication of nanostructures, nano-gap electrodes or molecular arrays and its application to nano-device. However, it is not appropriate for the fabrication of sub-5 nm features and high-aspect-ratio nanostructures due to the limitation of EBL resolution.

In this study, the precision assembly and alignment of DNA molecule was demonstrated using sub-5 nm nanostructures formed by a combination of conventional electron-beam lithography (EBL) and plasma ashing processes. The ma-N2401 (EBL-negative tone resist) nanostructures were patterned by EBL process at a dose of 200 μ C/cm2 with 25 kV and then were ashed by a chemical dry etcher at microwave (μ W) power of 50 W. We confirmed that this method was useful for sub-5 nm patterning of high-aspect-ratio nanostructures. In addition, we also utilized the surface-patterning technique to create the molecular pattern comprised 3-(aminopropyl) triethoxysilane (APS) as adhesion layer and octadecyltrichlorosilane (OTS) as passivation layer. DNA-templated gold nanoparticle chain was attached only on the sub-5 nm APS region defined by the amine groups, but not on surface of the OTS region. We were able to obtain DNA molecules aligned selectively on a SiO2/Si substrate using atomic force microscopy (AFM).